HYDROLOGY/HYDRAULIC/SCOUR REPORT

The estimated flow values shown below are based on a drainage area of 5.1 sq. miles and were calculated using Potter's Method, USGS Method, and FHWA Method and then averaged. Benson's Method yielded a significantly lower flow value and was not considered in calculating the average flow. In addition, the rainfall event of March 2001 was analyzed using HydroCad. The flow from the March 2001 storms in combination with ice and frozen ground conditions equates to an approximate 100-year storm flow at the bridge location. Those results are included in the Q_{100} average.

Drainage Area	5.1 sq mi
Design Discharge (Q50)	619 cfs
Check Discharge (Q100)	750 cfs
Ordinary High Water (Q1.1)	198 cfs

Recollections from residents (excerpt from CLD Site Observation Report dated August 20, 2001):

The highest [Mr. and Mrs. Littlefield] remember the stream was during Hurricane Bob which was in August 1991, when their neighbor across the stream had just moved in. The water level was close to the top of the arch. Mrs. Littlefield noted that she could feel the vibration on top of the bridge from the water passing through it. They said the water commonly backs up behind the bridge during spring runoff, but the water levels are generally only ¼ to ½ way up the arch. Generally in a large flood, the water level just downstream of the bridge is controlled by backwater from the Saco, since they have seen it very slow moving but high.

Only one of the alternatives considered during the course of preliminary design would improve the hydraulic performance of the stream. (See Summary of Preliminary Design for description of alternatives) Each of the alternatives, however, does stabilize the stone arch to better withstand the forces imposed by the flood events. The alternative which replaces the stone arch with a precast arch bridge, is the only option that would result in an improvement in hydraulic performance.

For all alternatives except replacement with a precast arch bridge, a simple open channel flow calculation was performed for the existing stone arch using Manning's equation based on a rectangular opening. The calculated height of water and velocity are reported below.

Estimated Water Depth at:	Q_{50} = 12.9 ft	at:	Q_{100} = 15.4 ft
Estimated Velocity at:	Q_{50} = 5.83 fps	at:	Q_{100} = 5.93 fps

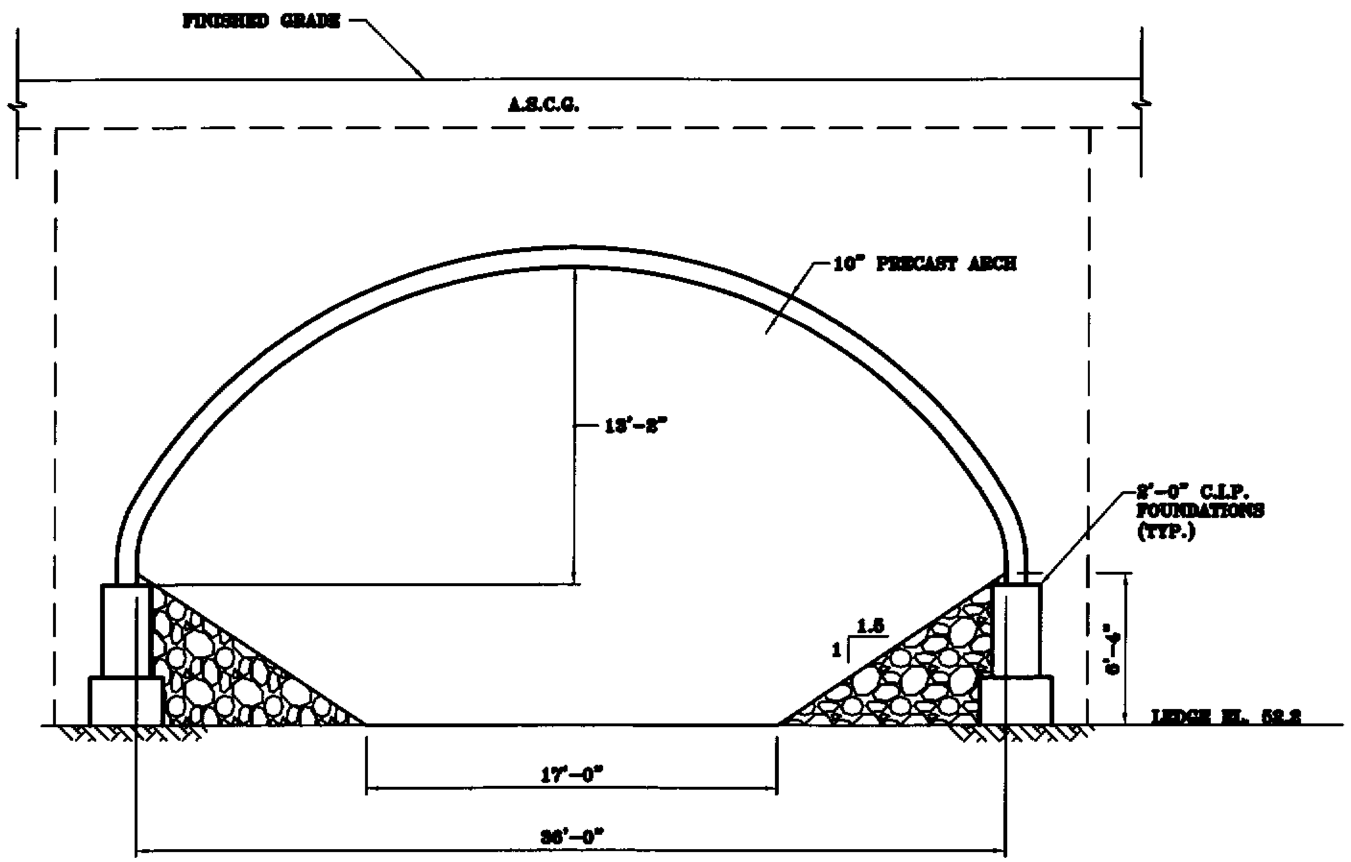
For the alternative with a precast arch bridge, a simple open channel flow calculation was performed using Manning's equation for a wider trapezoidal opening that would result if a longer span precast arch were constructed. The calculated height of water and velocity are reported below.

Estimated Water Depth at:	Q_{50} = 4.5 ft	at:	Q_{100} = 4.8 ft
Estimated Velocity at:	Q_{50} = 6.26 fps	at:	Q_{100} = 6.56 fps

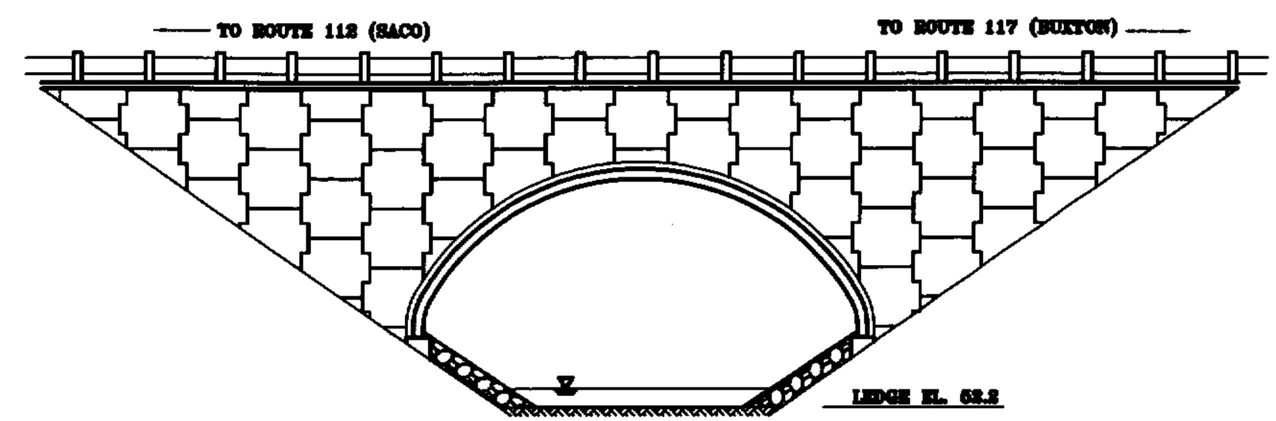
Note the water depth is significantly reduced for the precast arch alternative, while the velocity is calculated to be higher. In practicality, the velocity at the exit of the existing culvert for flows of Q50 or higher would be anticipated to be above those calculated using the steady flow assumption of the Manning's equation. The pressure on the upstream face as a result of the backwater would also increase the stream velocity at the exit. This is not accounted for in the open channel results reported above.

Hydraulic analyses for the estimated Q100 flow yielded a depth of flow through the bridge site of 15.4 feet, with an average cross-sectional velocity of 6 fps. That depth of flow would be at about the springline of the arch, consistent with elevations from the FEMA Floodway maps, as well as local observations. At Q50 the water depth is 12.9 feet resulting in an Hw/D equal to 0.7 that is less than the MaineDOT Bridge Highway Design Manual design criterion of 0.9.

Scouring has had a significant effect on the structure's foundation. There were several areas that had scoured away beneath foundation stones as well as a large scour hole on the downstream, right-hand (looking downstream) corner of the bridge. In addition, the large pool area directly downstream of the bridge would be indicative of significant velocities discharging from the structure. This magnitude would be comparable with resident and local officials observations of the actual velocities noted during spring runoff and storm events. In combination with stone movement due to foundation erosion, the localized velocities around the shifted stones could cause significant enough forces to remove stones and mortar from the walls.



BRIDGE TYPICAL SECTION – FULL REPLACEMENT
SCALE: 1/4" = 1'-0"



BRIDGE ELEVATION – FULL REPLACEMENT
SCALE: 1/8" = 1'-0"

NO.	DATE	REVISION

DRAWN: DAD
DESIGNED:
CHECKED:
APPROVED:

CLD CONSULTING ENGINEERS

CLIENT: CITY OF SACO
300 MAIN STREET
SACO, MAINE 04072

SIMPSON ROAD BRIDGE
OVER STACKPOLE CREEK

SCALE:	JOB NO.
1" = 20'	01-0159
DATE: JUNE, 2008	DWG.

F:\Pro\2001\010159Simpson Road\Bridge2\Drawings\ex_elevation.dwg